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Comments:
here is a copy of the translation of JP 60-067636A, cited in the last office action.

Jan Mor

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Japanese Published Unexamined Patent Application (A) No. 60-067636, published April 18, 1985; Application Filing No. 58-172252, filed September 20, 1983; Inventor(s): Teruo Uno; Assignee: Sumitomo Light Metal Engineering, Inc.; Japanese Title: Aluminum Alloy for VTR Cylinders

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ALUMINUM ALLOY FOR VTR CYLINDERS

CLAIM(S)

An aluminum alloy for a video tape recorder (VTR) cylinder that contains one or more elements selected from among Cu 2 – 5%, Mg 0.5 – 2%, Fe 0.25% or less, Si 0.20% or less, Li 0.001 – 0.20%, Zr 0.05 – 0.25%, Cr 0.05 – 0.25%, Mn 0.1 – 0.8%, V 0.05 – 0.25%, and an aluminum and impurities for the remaining portion.

DETAILED DESCRIPTION OF THE INVENTION

(Technical Field)

The present invention pertains to an aluminum alloy for a VTR cylinder, particularly to an aluminum alloy excellent in tape traveling, anti-abrasion, and cutting.

(Prior Art)

For a cylinder which is one of the essential components in a VTR, high quality and high precision are required. The following properties in particular are required.

1) Non-magnetic body.

2) Lightweight for high-speed rotation.

3) Excellent tape traveling.

4) The cylinder is not abraded by the tape.

5) The cylinder can be cut smoothly with a good finished surface.

For the prior art VTR cylinder, JIS AC5A cast alloy or JIS 2218 cast alloy was used. The AC5A cast alloy, however, comes with the following problems: 1) Many surface defects in micro order are generated in a final precision cut member due to minute oxides, nest, and eutectic compounds, and magnetic powder from the magnetic tape is accumulated in these defects, causing defective images; 2) The tape-rotating components need to be strong enough not to be abraded by the tape and need to have an anti-abrasion property, but its hardness (Vickers hardness of about 120) is not high enough, so the large eutectic compounds and intermetallic compounds are generated, leading to poor anti-abrasion; 3) Since minute compound grains with about a 10 – 30 1m size are dispersed at about 20 1m space intervals, the abrasion between the tape and its rotating components is high, leading to the tape's

poor traveling; 4) The tape-rotating components are processed by cutting, but they cannot be cut well and have a poor surface condition after having been put to precision cutting.

In order to solve the aforementioned problems, the JIS AC5 alloy and 2218 cast alloy were developed and put to practical use, but to improve the VTR performance, even a higher performance alloy for the cylinder has been demanded.

With the AC5A cast alloy and 2218 alloy, a relatively large amount of Fe group or Ni group eutectic compounds and intermetallic compounds were generated. The 2218 alloy is more improved than the AC5 alloy in the generation of these compounds, but the Fe or Ni intermetallic compounds with average gain size 5 1 or less are still present in it. Therefore, when the 2218 alloy is used as the VTR cylinder material, the following problems arise: 1) The surface roughness is high after put to mirror-finish precision cutting due to the presence of Ni or Fe intermetallic compounds; 2) Accordingly, the abrasion between the cylinder and the magnetic tape is high, so the tape traveling is not stable and the cylinder is abraded by the tape, leading to defective images.

(Objective)

The present invention, to solve the aforementioned problems and to contribute to the higher performance of a VTR, attempts to present an aluminum alloy free from the problems with the AC5A cast alloy, more excellent in the finished cut surface, smaller in abrasion coefficient between the cylinder and the tape, and excellent in anti-abrasion and tape traveling.

(Structure)

The present invention presents an aluminum alloy for a VTR cylinder that contains one or more elements selected from among Cu 2 – 5%, Mg 0.5 – 2%, Fe 0.25% or less, Si 0.20% or less, Li 0.001 – 0.20%, Zr 0.05 – 0.25%, Cr 0.05 – 0.25%, Mn 0.1 – 0.8%, V 0.05 – 0.25%, and an aluminum and impurities for the remaining portion.

More specifically, the aluminum alloy of the present invention, unlike the aforementioned AC5 alloy and 2218 alloy, does not contain Ni, but contains a minimal amount of Fe and Si, while simultaneously containing one or more elements selected from among Zr, Mn, Zr and V.

The reason for determining the components of the alloy of the present invention as above is the following.

Cu: When Cu coexists with Mg, it provides the alloy with age hardening and improves the anti-abrasion and strength. If the amount used is less than the

minimal limit, the effect will not be sufficient, but if the amount used is more than the maximum limit, the anti-corrosive property will be reduced.

Mg: Mg provides the alloy with age hardening when it coexists with Cu and improves the strength and anti-abrasion. With the amount less than the minimal limit, the effect will be insufficient,but with the amount exceeding the maximum limit, the hot rolling working processability and cold working processability will be reduced.

Fe, Si: Fe and Si form insoluble compounds, contributing to the roughness of the surface at a time of mirror finish cutting and to the poor tape traveling and low anti-abrasion. Accordingly, these compounds are used by lesser amount than the maximum limit. For the base metal, two or more types of special JIS aluminum base metal are used.

Zr, Mn, Cr, V: These elements are effective for improving the strength and miniaturizing the crystalline grains and also improve the anti-abrasion of aluminum alloy. With the amount less than the minimal limit, the effect will be insufficient, but with the amount exceeding the maximum limit, large intermetallic compounds will be generated, and the surface condition after the cutting will be poor.

Ti: Ti miniaturizes the structure of the cast mass, preventing the cracks at a time of casting. With the amount less than the minimal limit, this effect will

be insufficient, but with the amount exceeding the maximum limit, the surface condition after the cutting will be reduced.

Manufacturing Steps

A) Molten processing

When the aluminum alloy having the aforementioned composition is melted and cast, a filter process is conducted to remove minute oxides before casting into a mass. If large oxides are remained, the surface defects will be generated at a time of mirror finishing the VTR cylinder.

B) Homogenization

The structure of the cast mass is homogenized and is heated to melt the major elements in the alloy. The process is preferably conducted at 400 - 4800C for 2 – 48 hours.

C) Extrusion

The cast mass is put to a hot working extrusion process at a process level higher than at least 75% (reduction rate of the sectional dimension) at 300 - 4800C. If the process level is less than 75%, the pin holes, blow holes,

and nests present in the cast mass are not sufficiently compressed, and it will not be desirable if they are remained after the extrusion.

D) Stretching

This is done if necessary for size matching.

E) Casting process

The cylinder shape is formed from the extruded material. The casting can be done by hot working or cold working, but the cold working cast is preferable in terms of cost and size accuracy.

F) Heating

After the casting, annealing is conducted to provide the alloy with the prescribed strength.

G) Finishing process

After the heating process, the mirror-finishing process is conducted to make the VTR cylinder.

The alloy of the present invention can be most functional when it is put to the aforementioned steps, but even if the cast member of the alloy of the present invention is put to E) → F) → G) only, the VTR cylinder can be more improved than the prior art AC5A and 2218 cast alloys.

(Embodiment Example)

Table 1 below shows the chemical components used in the present invention.

The alloy of the present invention was put to a filtering process after melted and cast into a round mass with 8" diameter.

This cast mass was put to extrusion to form it into 50 ø mm rod at 4400C after homogenized under 4650C x 24 hours. It was stretched after softened under 4100C x 1 hour, and formed into the VTR cylinder by cold casting. After this component was put to T6 process (4900C x 1 hour →water cooling →1750C x 8 hours), it was cut into the VTR cylinder with mirror surface finish.

(Effect)

Table 2 shows the performance in various respects.

The alloys, No. 1 – 8, of the present invention had an excellent finished surface after the cutting process and had a low abrasion coefficient, so the tape traveled smoothly and the abrasion amount of the tape was minimum.

The comparative alloys, No. 9 –10, were not hard enough and had poor anti-abrasion.

The comparative alloys, No.11 – 13, and 2218 alloy were rough on the surface and had problems with the tape traveling and anti-abrasion.

The comparative alloy, No. 14, had large crystalline grains, therefore, had uneven finished surface, and its tape traveling was poor.

Table 1 Chemical components in the embodiment example (%)

表1 実施例の化学成分（%）

	No.	Cu	Mg	Fe	Si	Zr	Mn	Cr	V	Ti	Zn	Al
本発明例	1	4.0	1.48	0.09	0.06	0.12	—	—	—	0.01	0.01	残
	2	3.9	1.63	0.17	0.10	0.10	—	—	—	0.01	<0.01	〃
	3	4.3	1.37	0.23	0.14	0.15	—	—	—	0.02	0.01	〃
	4	3.7	1.8	0.15	0.08	0.12	—	—	0.08	0.01	<0.01	〃
	5	2.5	1.5	0.13	0.07	0.11	—	0.12	—	0.01	0.01	〃
	6	4.6	1.4	0.12	0.07	0.12	0.55	—	—	0.01	0.01	〃
	7	4.0	1.3	0.10	0.07	0.11	0.15	0.08	0.07	0.01	0.01	〃
	8	4.3	0.9	0.12	0.08	0.11	0.25	—	—	0.01	0.01	〃
比較例	9	1.5	1.5	0.12	0.08	0.15	—	—	—	0.01	0.01	〃
	10	4.0	0.2	0.13	0.12	0.12	—	—	—	0.01	0.01	〃
	11	4.0	1.4	0.30	0.13	0.14	—	—	—	0.01	0.01	〃
	12	4.0	1.39	0.18	0.10	0.30	—	—	—	0.01	0.01	〃
	13	4.3	1.6	0.15	0.09	0.27	—	0.29	—	0.01	0.01	〃
	14	3.7	1.4	0.12	0.07	0.01	—	—	—	0.01	0.01	〃
	2218	4.1	1.39	0.34	0.56	—	—	—	Ni 1.95	0.01	0.01	〃

In the table, No. 1 – 8 indicate the alloys of the present invention, and No. 9- 14 indicate the comparative examples. The characters in the boxes underneath Al means the remaining portion.

Table 2 Performance comparison

表2 諸性能比較結果

No.	硬 度 Hv5Kg	切削面の面粗度（μ） *1	摩耗量（μ） *2	摩擦係数 *3	テープ走行性
1	136	0.08	0.5	0.01	良
2	135	0.1	0.6	0.01	〃
3	139	0.14	0.7	0.015	〃
4	135	0.12	0.6	0.012	〃
5	143	0.12	0.6	0.009	〃
6	140	0.10	0.5	0.01	〃
7	133	0.13	0.6	0.01	〃
8	130	0.11	0.5	0.013	〃
9	95	0.12	6.5	0.012	〃
10	90	0.12	7.0	0.013	〃
11	135	0.39	3.5	0.05	不 良
12	133	0.45	4.9	0.07	〃
13	136	0.44	5.0	0.07	〃
14	127	0.15～0.5	0.5～3.0	0.01	〃
2218	130	0.58	5.3	0.08	〃

*1 T目標のダイヤ仕上加工後の平均粗さ

*2 酸化鉄系磁気テープによる5000Hr 走行テスト後のシリンダーの摩耗量

*3 酸化鉄系磁気テープとの回転摩擦係数

In the table Hv5Kg indicates the hardness.

*1 indicates the average roughness after the diamond –finishing process.

*2 indicates the abrasion amount (1) of the cylinder after a 5,000 hour travel test of an iron oxide magnetic tape.

*3 indicates a rotation friction coefficient (1) of the cylinder with the iron oxide magnetic tape.

The characters in the far right top box means tape traveling, and the character underneath indicates “excellent” in the boxes 1 – 10. The two characters in the boxes 11 – 14 mean “not good.”

Translations
U. S. Patent and Trademark Office
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Akiko Smith